meter—taken by Capt. Winchester, R.N.R.—was 43° 08′. It should be, I think, "inner semidiameter." The first circumsolar bow has a semidiameter of 41° 37′. That is almost necessarily invisible. The second circumsolar bow has a semidiameter of 43° 52′, and is rarely visible. I have no doubt that was the bow witnessed on board the *Norham Castle* on August 16

Athenæum Club, September 7 C. M. INGLEBY

Flint Flakes Replaced

As this subject has been more than once adverted to in NATURE, the following recent instances of placing flint flakes on to their original position may be interesting:—

Whilst examining the relics from Cowper's Camp, Epping Forest, in Mr. Raphael Meldola's house last month, I looked over a small number of flakes collected from one spot in the

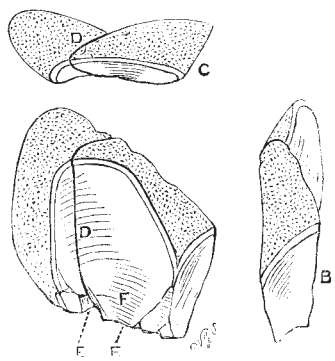

FIG. 1.

rampart of the camp, with remains of burnt wood and late Celtic pottery. I immediately saw that several of the flakes had been struck from the same block of flint, and after a short examination I managed to replace two as illustrated, one-half real size, in Fig. 1. The front of the two conjoined flakes is shown in the lefthand bottom figure, the side at B, the top at C, and the line of junction at D D. Behind E E are two cones of percussion, one belonging to each flake, and at F is the depression into which the cone of the missing frontal flake at one time fitted. The fractured part of the flint is deep chocolate brown, and lustrous, and the bark of the flint is dull ochreous; the flakes are undoubtedly artificial, and as old as the rampart of the camp, not less than two thousand years. This example, with other relics, will be placed in the Guildhall Museum.

Greater interest attaches to the replacing of Palæolithic flakes, as these are enormously older than Neolithic, and the chances are so very much against lighting on a perfectly undisturbed Palæolithic position.

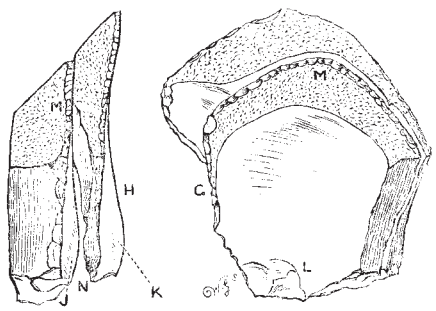

FIG. 2.

At Fig. 2 is illustrated (one-half actual size) two Palæolithic flakes from the "Palæolithic floor" at Stoke Newington Common, found and replaced by me. The front of the conjoined flakes is shown at G and the side at H. I found the lower flake two days before, and some distance from where I found the upper one; but as I have a method of placing newly found sharp flakes on a table, arranged temporarily in accordance with their colour and markings, I speedily saw that the upper flake would fit on to the lower one. Each flake has a cone of percussion, as shown at J K, and the upper flake has a well-marked depression at L, corresponding with the missing flake, which, if it had been found, would have fitted on to the front of the two conjoined examples. Both flakes are sharp and slightly stained with the ochreous river sand which overlaid them. Both (especially the upper one) show unmistakable signs of having been used as scrapers, the upper curved edge (and that edge only) being worn away by use. The worn upper edge of the superimposed flake at M M is distinctly shown in the illustration. A small intermediate piece belonging to the position at N I did not find. Both are naturally mottled in a peculiar manner, and the pattern and colour of the mottling exactly agree.

WORTHINGTON G. SMITH

NOTES ON THE POST-GLACIAL GEOLOGY OF THE COUNTRY AROUND SOUTHPORT

SINCE the writer carried out the geological survey of the western coast of Lancashire in 1868 he has constantly been asked, "Is there any geology to be studied at Southport? Is not the country a sandy expanse fringing peat-mosses of ceaseless monotony?" The meeting of the British Association this week at Southport renders this a fitting time to reply to these questions; for, strange as it may appear, in these apparently unpromising surroundings exists a record of the complete sequence of events from the commencement of the Glacial episode down to the present time. The sand dunes, rising to 50 and even 80 feet in height, that form so prominent a feature between Liverpool and Southport, rest upon a wedge-shaped mass of sand blown from the coast by westerly winds over the thick peat-mosses that intervene between the coast and the rising ground about Ormskirk; the surface of the Glacial beds, with the overlying deposits, dip steadily towards the sea, and fragments of peat are frequently trawled up by the fishermen.

Beneath the sand dunes on the sea coast the peat is seen cropping out, and at the base of the peat occur the roots of forest trees embedded in clay beneath, while trunks of trees lie scattered in many directions, but generally with their heads lying to the north-east, as if they had been blown over by a gale from the south-west. The bases of the trunks are left standing in the places where they grew; all appear to have been broken off at a uniform level, and it is most probable that through the drainage being obstructed water surrounded the trees, which gradually became rotten at the point of contact of the air and the water, and thus the way was prepared for the effects of storms and hurricanes. Sections of these beds near High Town, at the mouth of the Alt, will be found of great interest. Sections also occur on the coast at Dunkirk, near Crossens. At the Palace Hotel, Kirkdale, a boring was put down in 1867, that proved the sand to be 78 feet in thickness, resting on 18 inches of peat, which occurs at about 90 feet beneath high-water mark. When the land stood this amount above its present level, the coast would range in a straight north and south line from St. Bees Head to the mouth of the Clywd at Rhyl, but there is no reason to suppose that this amount represents the subsequent submergence since the era of the peat in Lancashire and North Wales. It is far more probable that when the trees flourished, found at the bottom of the peat fringing these coasts, this coast nearly coincided with the present twenty-fathom line, which passes from Anglesea round the Isle of Man; in that island the same sequence of post-glacial deposits is found, and the Irish elk alike occurs in the grey slags beneath peat.

At the mouth of the Ribble very interesting sections occur at Freckleton and Dow Brook; the latter is crossed by a Roman road, and has upon it a "Roman bath," only ten feet above the present high-water mark, proving the elevation of this coast has not been great since Roman times. The same fact is brought out by the interesting find of Roman coins near Rossal landmark, near Fleetwood, which were found in a salt-marsh clay lying on the peat beds, at about eight feet below the

surface, or at about high-water mark, the coins having been apparently lost by the Romans scrambling over the soft slippery mud. This discovery proves the thick peat beds to be of older date than the Romans; this is also borne out by the very remarkable sections along the north coast of Wirral, especially near Leasowe, which have afforded the fine collection of antiquities preserved in the Liverpool Free Museum; the silty beds over the peat yield Roman coins of Nero, Antoninus Pius, and Marcus Aurelius, while in the peat beds beneath occur flint implements of the Neolithic type. When the peat beds of Western Lancashire are followed into the valleys of the large rivers that traverse the country, they are found to pass insensibly into a peaty seam occurring at the base of the alluvium of the lowest plain of these rivers. This is well seen in the valley of the Ribble at Preston; it is more than a mile in width, and 180 feet in depth; it is excavated entirely in the Glacial deposits, down to the rocky floor, which lies somewhat below high-water mark, and nearer the sea slopes down considerably beneath it. On the slopes of the valley lie terraces of old alluvium, marking successive stages in the process of denudation, commenced since the deposition of the Upper Boulder Clay, as the bottom of the valley is the ordinary alluvial plain, made of silt, resting on a peaty bed, with trunks of trees lying on rough river gravel, the latter marking a period of great fluviatile denudation, when the land was at least as high, if not higher, above the sea as it is at present. To this era belong the marine beds lying beneath the peat I have called the *Presall shingle*, occurring east of Fleetwood, and the *Shirdley Hill sands* near Southport, which mark the position of old sea-beaches and old sand dunes respectively.

From these facts it appears that the excavation of the Western Lancashire river valleys was entirely carried out since the Glacial episode, that they had reached their present depth when Neolithic man inhabited the north-west of England, and that since that era much land has been destroyed, now covered by the Irish Sea, but since Roman times there has been but little change.

C. E. DE RANCE

THE BRITISH ASSOCIATION

THE Southport meeting promises to be one of the most successful since the Association met in Liverpool twelve years ago. According to the latest statistics it is expected that in attendance it may even rival the York meeting, when over 2500 people gathered to celebrate the jubilee of the Association. From the information we have already published it will have been seen that Southport has shown the greatest zeal in preparing to give a generous reception to the representatives of British science; and if only the weather be propitious, there can be little doubt that the meeting will be a success. Both the papers to be read and the reports to be presented are expected this year to suggest some specially interesting subjects for discussion.

Last night Sir C. W. Siemens resigned the presidential chair to Prof. Cayley, who then delivered the opening address.

INAUGURAL ADDRESS BY ARTHUR CAYLEY, M.A., D.C.L., LL.D., F.R.S., SADLERIAN PROFESSOR OF PURE MATHEMATICS IN THE UNIVERSITY OF CAMBRIDGE, PRESIDENT.

SINCE our last meeting we have been deprived of three of our most distinguished members. The loss by the death of Prof. Henry John Stephen Smith is a very grievous one to those who knew and admired and loved him, to his University, and to mathematical science, which he cultivated with such ardour and success. I need hardly recall that the branch of mathematics to which he had specially devoted himself was that most interesting and difficult one, the Theory of Numbers. The immense range of this subject, connected with and ramifying into so many others, is nowhere so well seen as in the series of reports on the progress thereof, brought up unfortunately only to the year 1865, contributed by him to the Reports of the Association; but it will still better appear when to these are united (as will be done in the collected works in course of publication by the Clarendon Press) his other mathematical writings, many of them containing his own further developments of theories referred to in the reports. There have been recently or are being published many such collected editions—Abel, Cauchy, Clifford, Gauss, Green, Jacobi, Lagrange, Maxwell, Riemann, Steiner. Among these the works of Henry Smith will occupy a worthy position.

More recently, General Sir Edward Sabine, K.C.B., for twenty-one years general secretary of the Association, and a trustee, president of the meeting at Belfast in the year 1852, and for many years treasurer and afterwards president of the Royal Society, has been taken from us at an age exceeding the ordinary age of man. Born October, 1788, he entered the Royal Artillery in 1803, and commanded batteries at the siege of Fort Erie in 1814; made magnetic and other observations in Ross and Parry's North Polar exploration in 1818–19, and in a series of other voyages. He contributed to the Association reports on Magnetic Forces in 1836-7-8, and about forty papers to the *Philosophical Transactions;* originated the system of Magnetic Observatories, and otherwise signally promoted the science of Terrestrial Magnetism.

There is yet a very great loss: another late president and trustee of the Association, one who has done for it so much, and has so often attended the meetings, whose presence among us at this meeting we might have hoped for—the president of the Royal Society, William Spottiswoode. It is unnecessary to say anything of his various merits: the place of his burial, the crowd of sorrowing friends who were present in the Abbey, bear witness to the esteem in which he was held.

I take the opportunity of mentioning the completion of a work promoted by the Association: the determination by Mr. James Glaisher of the least factors of the missing three out of the first nine million numbers: the volume containing the sixth million is now published.

I wish to speak to you to-night upon Mathematics. I am quite aware of the difficulty arising from the abstract nature of my subject; and if, as I fear, many or some of you, recalling the Presidential Addresses at former meetings—for instance, the *résumé* and survey which we had at York of the progress, during the half century of the lifetime of the Association, of a whole circle of sciences—Biology, Palæontology, Geology, Astronomy, Chemistry—so much more familiar to you, and in which there was so much to tell of the fairy-tales of science; or at Southampton, the discourse of my friend who has in such kind terms introduced me to you, on the wondrous practical applications of science to electric lighting, telegraphy, the St. Gothard Tunnel, and the Suez Canal, gun-cotton, and a host of other purposes, and with the grand concluding speculation on the conservation of solar energy: if, I say, recalling these or any earlier addresses, you should wish that you were now about to have, from a different president, a discourse on a different subject, I can very well sympathise with you in the feeling.

But, be this as it may, I think it is more respectful to you that I should speak to you upon and do my best to interest you in the subject which has occupied me, and in which I am myself most interested. And in another point of view, I think it is right that the Address of a President should be on his own subject, and that different subjects should be thus brought in turn before the meetings. So much the worse, it may be, for a particular meeting; but the meeting is the individual, which on evolution principles must be sacrificed for the development of the race.

Mathematics connect themselves on the one side with common life and the physical sciences; on the other side with philosophy, in regard to our notions of space and time; and in the questions which have arisen as to the universality and necessity of the truths of mathematics, and the foundation of our knowledge of them. I would remark here that the connection (if it exists) of arithmetic and algebra with the notion of time is far less obvious than that of geometry with the notion of space.

As to the former side, I am not making before you a defence of mathematics, but if I were I should desire to do it—in such manner as in the "Republic" Socrates was required to defend justice, quite irrespectively of the worldly advantages which may accompany a life of virtue and justice, and to show that, independently of all these, justice was a thing desirable in itself and for its own sake—*not* by speaking to you of the utility of mathematics in any of the questions of common life or of physi-